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This paper presents the development of a general method of ascertaining the relation between a dependent variable and each of a number of mutually correlated ones *without being compelled to employ an assumed or predetermined mathematical function*. This is accomplished by applying to the observed values of the dependent variable successive corrections based upon each value of all the independent variables. In this way is obtained a series of averages of the dependent variable corresponding to a series of averages of each one of the independent variables in turn and corrected to a constant value of each of the remaining ones. The method is concretely illustrated by an application to a bioclimatic problem; that of predicting the yield of South Dakota wheat from temperature and precipitation.

A limited number of reprints are available for distribution. Requests for them should be mailed to the Scripps Institution, La Jolla, California.

GEO. F. McEWEN  
ELLIS L. MICHAEL

#### THE AMERICAN CHEMICAL SOCIETY VII

*Calorimetric determinations of the energy in yolk-protein and yolk-fat of doves and pigeons:* OSCAR RIDDLES. Individual entire egg-yolks were separated into (boiling) alcohol-ether soluble and insoluble fractions. These moisture-free portions considered as yolk-protein and yolk-fat were burned in a Riche bomb calorimeter. Determinations were separately made upon yolks from various pure species and hybrids. The energy per gram of the yolk-protein of pure species averages 5,497 (small) calories; for hybrids practically the same (5,457). The energy per gram of yolk-fat of pure species averages 9,020 calories; for hybrids probably it is less (8,897). The range of variability for yolks from individual hybrids is plainly greater than for yolks from pure species.

*Some properties of the placental hormone:* PAUL M. GIESY. This substance, injected subcutaneously into the female animals, causes growth of the mammary glands and uterus. It was extracted by treating ground placentas with alcohol. In water, some, but not all, of the substance dissolves. It is dissolved by benzene, chloroform, carbon tetra-

chloride, absolute alcohol, ether and ethyl acetate, but not by petroleum ether. If the extract is shaken with a mixture of water and benzene, the benzene solution alone is physiologically active. Alcoholic solutions and aqueous emulsions lose their activity on standing. The activity appears to be destroyed by continued heating.

*The preparation of fatty acid esters of cholesterol:* G. D. BEAL AND J. B. BROWN. (By title.)

*Comparative analysis of fibrin in the presence of various aldehydes:* GEORGE E. HOLM AND ROSS AIKEN GORTNER. The comparative action of various amounts of paraldehyde, benzaldehyde, butyl and isobutyl aldehydes to that of formaldehyde when present in the acid hydrolysis of fibrin and gelatin was studied. In all cases the acid insoluble humin nitrogen increase is greater than with  $(\text{CH}_2\text{O})_2$ , and a maximum is reached and maintained even in the presence of large excesses of these aldehydes. The ammonia nitrogen, soluble humin nitrogen and total amino nitrogen of the filtrates from the "humin" do not alter significantly. Using trioxymethylene, the increase in insoluble humin nitrogen is due to the presence of the indole nucleus, while with the other aldehydes tyrosin also enters into this reaction.

*The preparation of cholesterol in quantity:* PAUL M. GIESY. One hundred pounds of cattle spinal cords were ground, dehydrated with alcohol and extracted fourteen times with ether. The ether was evaporated from the extract, and the residue saponified by boiling with alcoholic sodium hydroxide. After evaporating the alcohol, the residue was taken up in water and extracted with ether. The ether was evaporated from the extract, and the cholesterol crystallized from alcohol. The first crop was cream-colored and melted at  $147.1^\circ$  corrected. The second crop was brown, and melted at  $146.4^\circ$ . The total yield is about two pounds. The color can be removed by recrystallization from alcohol.

*The influence of aspartic acid and asparagin upon the enzymic hydrolysis of starch:* H. C. SHERMAN AND FLORENCE WALKER. (By title.)

*An improved technic for measuring lipase activity in animal or plant extracts or tissues:* LEROY S. PALMER (By title.) The material to be tested is added in the form of an extract or finely minced paste to at least 75 c.c. of artificial "milk," prepared by grinding a suitable oil into hydrated acacia and diluting the emulsion with water.  $\text{HCHO}$  1:1,500 is added to the "milk" as preservative. The initial acidity is determined by with-

drawing a 25 c.c. aliquot and adding it to 100 c.c. of acetone-ether (2:1), and titrating with 0.1 N alcoholic KOH solution, using phenolphthalein as indicator. The remainder of the "milk" is incubated for 24 hours at 38° C., with occasional rotation of the flask, and the titration repeated on another 25 c.c. aliquot. The features of the method are, (1) the use of an artificial "milk" containing no acid producing substances other than the emulsified oil, (2) the determination of the acidity on aliquot portions of the emulsion.

*The influence of various antiseptics on the activity of lipase:* LEROY S. PALMER. (By title.) The activity of a commercial lipase was tested using the technic described in the previous abstract. Chloroform, iodoform and acetone were found to have a marked retarding influence on the lipase, depending on the concentration of the antiseptic. Very small quantities of mercuric chloride and iodine, each completely paralyzed the lipase activity. Formaldehyde had no retarding effect up to one part in 250, concentrations between 1:1,000 and 1:2,000 actually having a noticeable accelerating effect on the lipase activity.

*The activity of phytase as determined by the specific conductivity:* F. A. COLLATZ AND C. H. BAILEY. (By title.) The hydrolytic cleavage of phytin by phytase results in the appearance of salts of phosphoric acid in the digestion mixture. The electrical conductivity of the latter is thereby increased, and may be employed as a measure of the progress of the reaction. To a water solution of phytin was added crude phytase prepared from wheat bran, and several such preparations were incubated at temperatures differing by 5° intervals from 25° to 60°. The electrical conductivity was measured every 15 minutes until it ceased to change materially. The rate of hydrolysis was accelerated by increased temperatures up to 55°, which appeared to be the optimum for this enzyme. Plotting the data, calculated to conductance at 30° in order to compensate for increased mobility of the ions at higher temperature, the curves have different shapes at each temperature. As the temperature increases to the optimum, the increase in conductivity per unit of time is more rapid at the outset, but also reaches approximate equilibrium more promptly.

*The fermentation of fructose by a group of pentose-fermenting bacteria:* W. H. PETERSON, E. B. FRED AND A. DAVENPORT. In the fermentation of fructose by these organisms acetic and lactic acids are the chief end products. Coincident with the

production of these acids is the formation of mannitol to the extent of about 20-30 per cent. of the fructose. The mannitol thus formed can be fermented to acetic and lactic acids by the same bacteria that produced it. It is suggested that the fructose first breaks down into acetic and malic acids and the latter then undergoes decarboxylation yielding lactic acid. Evidence for regarding malic acid as an intermediate product is the fermentation of malic acid to lactic acid. The strong reducing conditions set up in the breaking down of fructose into acetic and malic acid probably brings about the reduction of another portion of the fructose to mannitol.

*Factors influencing the invertase activity of mold spores in sugar:* NICHOLAS KOPELOFF AND S. BYALL. (By title.) The invertase activity of the spores of *Aspergillus* S. Bainier, *Aspergillus niger* and *Penicillium expansum* is exhibited at concentrations of sugar varying from 10 to 70 per cent. It has also been found that the maximum invertase activity of these mold spores occurs between 50 and 60 per cent. concentrations. It was noted that an increase in the number of mold spores is responsible for increased invertase activity in a saturated sugar solution. However, the least number of spores per c.c. of *Penicillium expansum* and *Aspergillus niger* required to produce inversion in saturated sugar solution is between 50,000 and 110,000. About 5,000 spores of *Aspergillus* S. Bainier are needed to cause inversion. The evidence that mold spores alone are capable of deteriorating cane sugar is corroborated by the data herein presented.

*Carbon nitrogen ratio in relation to plant metabolism:* A. M. GURJAR. (By title.) The supply of nitrogen determines the relative proportion of carbohydrates and proteins in the tomato plant. Changes in these proportions are accompanied by very marked changes in the metabolism of the plant, as follows: (a) Although the C:N ratio may be as high as 19 and as low as 2, the fruiting takes place only between the ratios 4 and 6. (b) respiration varies directly as the value of C:N ratio. (c) Photosynthesis varies inversely as the value of C:N ratio. (d) In nitrogen starved plants, catalase activity is not parallel to respiration, but varies inversely with it. (e) Under etiolation, the high carbohydrate plants are reduced to protoplasmic respiration sooner than the low carbohydrate plant, which means that the enzyme system of the former fails to make available the starch reserve. (f) The high carbohydrate plants

have higher respiration at 20 c.c. C., but this is not the case at 10° C. and 30° C. The above observations on tomato, together with confirmatory data on turnips and radishes, emphasize the importance of determining the proper C: N ratios for all our economic plants.

*Vanillyl acyl amides*: E. K. NELSON. (By title.) Following the demonstration of the structure of capsaicin, the pungent principle of red pepper, which proved to be a condensation compound of vanillyl amine (4-hydroxy-3-methoxy benzylamine) with a decenoic acid, a number of analogous derivatives of vanillyl amine were prepared by the interaction of that substance with acyl chlorides. Derivatives of the following acids were obtained: acetic, propionic, butyric, isobutyric, n-hexonic, n-heptonic, n-octonic, n-nonic, n-decenoic, n-undecenoic, n-dodecenoic, crotonic, undecenoic and benzoic. As the molecular weights of these substances rise, the solubility in water decreases, while that in ether increases. Pungency, first noticeable in the propionyl compound, increases to a maximum in vanillyl octoyl amide, which is almost as pungent as capsaicin. One eight-thousandth of a milligram of this substance causes a distinct burning on the tongue. The crotonyl compound is slightly, the undecenyl compound extremely, and vanillyl benzoyl amide very slightly pungent.

*On a phenol produced by growing aspergillus tamari*: J. F. BREWSTER. (By title.)

*Climatic control in relation to plant growth*: W. E. TOTTINGHAM. (By title.) Consideration of the profound effects of climate upon the growth and composition of plants, together with the difficulties of interpretation of these effects imposed by fluctuations of climatic factors, makes evident the desirability of experimental control over the latter. A fair degree of success has been realized in the installation of a small plant culture chamber for climatic control within a greenhouse. The atmosphere is conditioned for this chamber by forcing it through a humidifying chamber moistened by wet towelling, the latter being wet by water of controlled temperature. Before entering the culture chamber the air is heated somewhat, to bring both its temperature and degree of saturation with water vapor to desired values. The conditioned air enters the culture chamber beneath the flanged surface of a rotating table, which distributes it about the chamber, and escapes through orifices at the top. The rotating table also serves to equalize climatic differences for the different plant cultures carried by it. With the limited capacity of such

an apparatus, it is necessary to maintain a considerable degree of control over illumination, temperature and humidity of the surrounding greenhouse, in order to realize a reasonable degree of control over climatic conditions within the culture chamber.

*Studies in the translocation of nitrogenous and carbohydrate material into the wheat kernel*: G. A. OLSON. (By title.)

*Physical and chemical studies of wheat gluten*: G. A. OLSON AND CHARLES H. HUNT. (By title.)

CHARLES L. PARSONS,  
Secretary

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### SECTION B—PHYSICS

Section B was in session, in affiliation with the American Physical Society, at St. Louis, December 30, and 31, 1919, and January 1, 1920. The program of papers presented through the American Physical Society are elsewhere announced and abstracted by the society. On the afternoon of December 31 occurred the annual session of Section B, the retiring vice-presidential address of Dr. Gordon F. Hull and a Symposium on "Phenomena in the Ultra-violet Spectrum, including X-rays," the papers of which will be abstracted elsewhere in SCIENCE under the above title. Dr. Hull's address on the subject, "Some Aspects of Physics in War and Peace," was printed in the issue of SCIENCE for February 5.

The Sectional Committee nominated as chairman of the Section, Professor J. C. McLennan, of the University of Toronto.

G. W. STEWART,  
Secretary

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